REMARKS

Claims 3-4 and 6-9 are pending in this application. In light of the remarks made herein, Applicant respectfully requests reconsideration and withdrawal of the outstanding rejections.

In the outstanding Official Action, the Examiner rejected claims 3-4 and 6-9 under 35 U.S.C. § 103(a) as being unpatentable over *Song et al.* (USP 6,542,201) in view of *Torimaru et al.* (USP 4,589,029). Applicant respectfully traverses this rejection.

In response to the Examiner's rejection of claims 3-4 and 6-9 under 35 U.S.C. § 103(a) as being unpatentable over *Song et al.* in view of *Torimaru et al.*, Applicant is filing concurrently herewith a verified translation of the priority document to establish an effective filing date of July 30, 1999, which is prior to the February 25, 2000, filing date of the *Song et al.* reference. As such, Applicant respectfully submits that *Song et al.* does not qualify as prior art and its removal as a reference obviates this rejection.

Applicant respectfully requests that this Amendment Under 37 C.F.R. § 1.116 be entered by the Examiner, placing claims 3-4 and 6-9 in condition for allowance.

Conclusion

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Catherine M. Voisinet (Reg. No. 52,327) at the

telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

Applicant respectfully petitions for a one (1) month extension of time pursuant to 37 C.F.R. §§ 1.17 and 1.136(a). A check in the amount of $110.00 in payment of the extension of time fee is attached.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

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Attachment: Verified Translation of JP 11-216059

VERIFICATION OF A TRANSLATION

I, the below named translator, hereby declare that:

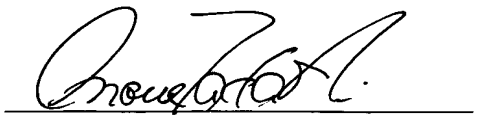
My name and post office address are as stated below;

That I am knowledgeable in the English language and in the language in which the below identified Japanese patent application was filed, and that I believe the English translation of the Japanese Patent Application No. 11-216059 filed on July 30, 1999 is a true and complete translation of the above identified application as filed.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application of any patent issued thereon.

Date
September 30, 2004

Full name of the translator INOUE Tadashi

Signature of the translator 

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[DOCUMENT NAME] Application for Patent

[REFERENCE NO.] 99019

[FILING DATE] Jul 30, 1999

[ADDRESS TO] Director General of the Patent Office

[INTERNATIONAL PATENT CLASSIFICATION] H04N 5/225

[TITLE OF THE INVENTION] DIGITAL CAMERA AND METHOD OF CONTROLLING OPERAION OF SAME

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[REPRESENTATION OF FEE]
[Prepayment Register No.] 006932
[Amount of Payment] 21000

[LIST OF FILING ITEMS]

[Name of Items]	Specification	1
[Name of Items]	Drawings	1
[Name of Items]	Abstract	1

[General Power of Attorney]	9800030
[General Power of Attorney]	9800031

[NEED OF PROOF] YES

[DOCUMENT NAME] SPECIFICATION

[TITLE OF THE INVENTION]

DIGITAL CAMERA AND METHOD OF CONTROLLING OPERATION OF SAME

[Scope of Claims for a Patent]

[Claim1] A digital camera comprising:

imaging means for imaging a subject at a fixed period by a solid-state electronic image sensing device and outputting a video signal, which represents the image of the subject obtained by imaging, upon downsampling the video signal at a given downsampling ratio;

electronic-zoom command means for applying an electronic zoom command and a zoom magnification;

zoom means for subjecting the video signal output from said imaging means to electronic zoom processing in accordance with the zoom magnification, which has been applied from said electronic-zoom command means, in such a manner that an image represented by the video signal output from said imaging means will be enlarged;

display control means for performing control in such a manner that the image represented by the video signal output from said imaging means will be displayed on said display device; and

downsampling-ratio control means for reducing the downsampling ratio in response to application of the electronic zoom command from said electronic-zoom

command means.

[Claim2] The digital camera according to claim 1, wherein said downsampling-ratio control means reduces the downsampling ratio by making number of lines of an image represented by a video signal that has undergone zoom processing by said zoom means greater than number of lines of an image represented by a video signal output from said imaging means.

[Claim3] The digital camera according to claim 1, wherein said imaging means outputs a video signal in sync with a synchronization signal applied thereto; and

said downsampling-ratio control means reduces the downsampling ratio in sync with the synchronization signal.

[Claim4] The digital camera according to claim 1, wherein the camera is provided with a mode setting means for setting an image-quality priority mode;

said downsampling-ratio control means reducing the downsampling ratio when the image-quality priority mode has been set by said mode setting means.

[Claim5] A digital camera having an imaging means for imaging a subject at a fixed period by a solid-state electronic image sensing device and outputting a video signal, which represents the image of the subject obtained by imaging, upon downsampling the video signal at a given downsampling ratio, said method comprising the steps of:

applying an electronic zoom command and a zoom magnification;

subjecting the video signal output from the imaging means to electronic zoom processing in accordance with the applied zoom magnification in such a manner that an image represented by the video signal output from the imaging means will be enlarged;

displaying the image represented by the video signal, which has been subjected to the electronic zoom processing, on the display device; and

reducing the downsampling ratio in response to application of the electronic zoom command.

[Detailed Description of the invention]

[0001]

[Technical Field]

This invention relates to a digital camera capable of electronic zoom processing, and to a method of controlling the operation of the camera.

[0002]

[Background of the Invention]

In a portable image pick-up apparatus such as a digital camera, a subject is imaged by a solid-state electronic image sensing device such as a CCD. An image having a high resolution is obtained by providing the solid-state electronic image sensing device with a large number of pixels.

[0003]

Some digital cameras are provided with a display device, and shooting angle is decided while the image of the subject is displayed on the display device. The resolution of the display device provided on the digital camera is not high and is in general lower than that of the solid-state electronic image sensing device.

[0004]

In order to image a subject at a fixed period of 1/60 of a second using a solid-state electronic image sensing device and display the image of the subject, which is represented by a video signal obtained by such imaging, smoothly in the form of a movie on a display device provided on a digital camera, it is required that the number of lines in the vertical direction of the image represented by the video signal output from the solid-state electronic image sensing device approximate the number of lines of the display device. In order to achieve this, the device is driven in such a manner that signal charge, which has accumulated in the photoelectric transducers constituting the solid-state electronic image sensing device, will be read out at intervals of a plurality of lines, by way of example. This is referred to as "pixel downsampling".

[0005]

Digital cameras capable of electronic zooming also have come into widespread use. By applying a zoom

command, the image of a subject within a prescribed area is enlarged by interpolating pixels.

[0006]

When pixels are downsampled in order to display a moving image on the display device, resolution declines. If such an image is subjected to electronic zoom processing, often the image undergoes a further decline in resolution.

[0007]

[Disclosure of the Invention]

An object of the present invention is to arrange it so that there is no decline in resolution even if electronic zoom processing is executed.

[0008]

According to the present invention, the foregoing object is attained by providing a digital camera comprising: imaging means for imaging a subject at a fixed period by a solid-state electronic image sensing device and outputting a video signal, which represents the image of the subject obtained by imaging, upon downsampling the video signal at a given downsampling ratio; electronic-zoom command means for applying an electronic zoom command and a zoom magnification; zoom means for subjecting the video signal output from the imaging means to electronic zoom processing in accordance with the zoom magnification, which has been applied from the electronic-zoom command means, in such

a manner that an image represented by the video signal output from the imaging means will be enlarged; display control means for performing control in such a manner that the image represented by the video signal output from the imaging means will be displayed on the display device; downsampling-ratio control means for reducing the downsampling ratio in response to application of the electronic zoom command from the electronic-zoom command means.

[0009]

The present invention provides also an operation control method suited to the camera described above. Specifically, the present invention provides a method of controlling a digital camera having imaging means for imaging a subject at a fixed period by a solid-state electronic image sensing device and outputting a video signal, which represents the image of the subject obtained by imaging, upon downsampling the video signal at a given downsampling ratio, the method comprising the steps of: applying an electronic zoom command and a zoom magnification; subjecting the video signal output from the imaging means to electronic zoom processing in accordance with the applied zoom magnification in such a manner that an image represented by the video signal output from the imaging means will be enlarged; displaying the image represented by the video signal, which has been

subjected to the electronic zoom processing, on the display device; and reducing the downsampling ratio in response to application of the electronic zoom command.

[0010]

In accordance with the present invention, a subject is imaged at fixed periods by the imaging means. The latter is capable of outputting the image of the subject, which has been obtained by imaging, upon downsampling the image at a given downsampling ratio. The image of the subject is displayed on the display device by applying the video signal, which is output from the imaging means, to the display device. Since the pixels constituting the image of the subject rather than the image capable of being read by the imaging means are downsampled at a given downsampling ratio, a smooth moving image can be displayed on the display device. The downsampling may be performed by a downsampling circuit.

[0011]

When the electronic zoom command is applied, electronic zoom processing is carried out in accordance with the electronic zoom command. The enlarged image of the subject is displayed by applying the electronic zoom processed video signal to the display means.

[0012]

When the electronic zoom command is applied, the downsampling ratio is reduced. Accordingly, the

resolution of the image represented by the video signal output from the imaging means rises in comparison with the resolution that prevailed prior to the reduction in the downsampling ratio. Thus an image having a high resolution can be obtained even when electronic zoom processing is applied.

[0013]

By way of example, the downsampling ratio is reduced by making the number of lines of the image represented by a video signal that has undergone zoom processing greater than the number of lines of the image represented by the video signal output from the imaging means.

[0014]

When the video signal is output in sync with an applied synchronizing signal, it is advisable to reduce the downsampling ratio in sync with this synchronizing signal.

[0015]

By reducing the downsampling ratio, it is possible to prevent disturbance of the image of the subject represented by the video signal output from the imaging means.

[0016]

The camera may be provided with a mode setting means for setting an image-quality priority mode. In this case control is exercised in such a manner that

the downsampling ratio is reduced when the image-quality priority mode has been selected by the mode selecting means.

[0017]

Thus, the user can set whether to give priority to image quality or to a display of a smoothly moving image.

[0018]

[Description of the Embodiments]

Fig. 1 is a block diagram illustrating the electrical construction of a digital still camera according to a preferred embodiment of the present invention.

[0019]

The digital still camera has its operation controlled by a CPU 20.

[0020]

The digital still camera has an electronic zoom function. An output signal from a zoom switch 13, which is for applying an electronic zoom command and enlargement ratio (zoom magnification) and for designating a zoom area in which enlargement is to be performed, is input to the CPU 20.

[0021]

The digital still camera can be set selectively to an image-quality priority mode and a motion priority mode by a mode switch 14. A signal indicating the mode

setting is input from the mode switch 14 to the CPU 20. The image-quality priority mode is for raising image resolution by changing the driving scheme of a CCD 2, described later, when the electronic-zoom enlargement ratio exceeds a predetermined enlargement ratio. The motion priority mode gives priority to motion of an image (so as to smoothen the motion of the image), which is displayed on a display device 8, by fixing the driving scheme of the CCD 2.

[0022]

The digital still camera is further provided with a shutter-release button 15. A signal indicating depression of the shutter-release button 15 also is input to the CPU 20.

[0023]

A zoom motor 11 is controlled by the CPU 20. A zoom lens 1 is positioned by the zoom motor 11 in such a manner that the image of a subject is enlarged at an enlargement ratio supplied from the zoom switch 13. A light image representing the image of the subject is formed on the photoreceptor surface of the CCD 2 by the zoom lens 1.

[0024]

The CCD 2 is controlled by an imaging synchronization signal VI and other control signals output from a timing generator (TG) 12. The CCD 2 images a subject at a fixed period (1/60 of a second)

in sync with the imaging synchronization signal VI and outputs a video signal. The video signal output from the CCD 2 is input to an analog/digital conversion circuit 4 via a CDS (correlated double sampling circuit) 3. The analog/digital conversion circuit 4 converts the analog video signal to digital image data, which is input to a signal processing circuit 5.

[0025]

The digital image data undergoes processing such as a gamma correction and a white balance adjustment in the signal processing circuit 5. The latter includes also a function for executing electronic zoom processing (pixel interpolation processing). Image data output from the signal processing circuit 5 enters an encoder 6, which subjects the image data to prescribed encoding processing. The encoder 6 is provided with a reproduction synchronization signal VD from the CPU 20 and outputs the image data in sync with the reproduction synchronization signal VD.

[0026]

The digital image data is converted to an analog video signal by a digital/analog conversion circuit 7. The analog video signal resulting from the conversion is applied to the display device 8, whereby the image of the subject is displayed in the form of a movie at the fixed period.

[0027]

If the shutter-release button 15 is pressed, the image data output from the signal processing circuit 5 is input to a memory-card controller 9. The latter records the image data on a memory card 10.

[0028]

Fig. 2 shows the imaging area of the CCD 2, and Figs. 3 and 4 show the image of a subject, which is represented by a video signal output from the CCD 2 when the CCD 2 is driven for downsampling, and the image of the subject (display image) displayed on the display device 8. Figs. 5(A) to 5(C) show some pixels of the image represented by the video signal output from the CCD 2.

[0029]

The CCD 2 has 1280 pixels horizontally and 960 pixels vertically. If the shutter-release button 15 is pressed, a video signal composed of 1280 pixels horizontally and 960 pixels vertically is output from the CCD 2 (see Fig. 5(A)) and converted to digital image data, which is recorded on the memory card 10.

[0030]

The display device 8 is capable of displaying an image composed of 640 pixels horizontally and 480 pixels vertically.

[0031]

When a movie image is displayed on the display device 8 in the manner described above, the CCD 2 is

controlled by the timing generator 12 in such a manner that the number of pixels in the vertical direction will be reduced to one-fourth (this is referred to as "1/4-downsampling drive"). Since the number of pixels vertically of the image represented by the video signal output from the CCD 2 becomes one-fourth the number of pixels of the imaging area of CCD 2, read-out can be performed at high speed. Thus the movie image is displayed on the display device 8 smoothly. The image represented by the video signal output from the CCD 2 thus has 1280 pixels horizontally and 240 pixels vertically (see Figs. 3 and 5(C), in which the dashed lines indicate the downsampled pixels).

[0032]

A zoom area is designated by the zoom switch 13 in the image represented by these 1280 pixels in the horizontal direction and 240 pixels in the vertical direction. The signal processing circuit 5 executes electronic zoom processing in such a manner that the image in the designated zoom area is displayed in the area of the display screen of display device 8. For example, if an area composed of 640 pixels horizontally and 120 pixels vertically is designated as the zoom area, electronic zoom processing for interpolating four times the number of pixels in the vertical direction so as to display the image within this area in the area of the display screen of display device 8 is executed.

[0033]

In the digital still camera according to this embodiment, the CCD 2 can be driven in such a manner that the number of pixels vertically of the image represented by the video signal output from the CCD 2 becomes one-half the number of pixels vertically of the imaging area of the CCD 2 (this is referred to as "1/2-downsampling drive). Fig. 4 illustrates the image of the subject represented by the video signal output from the CCD 2 in accordance with 1/2-downsampling drive. An image having 960 pixels in the vertical direction becomes an image having 240 pixels in the vertical direction in accordance with 1/2-downsampling drive if an electronic zoom area identical with the electronic zoom area shown in Fig. 3 is designated (see Fig. 5(B)).

[0034]

Fig. 6 illustrates some of the pixels of an image represented by a video signal obtained by 1/4-downsampling drive and pixels in a case where an enlargement ratio of 2× has been applied.

[0035]

When 1/4-downsampling drive is performed, the CCD 2 outputs the video signal at a rate of one pixel per four pixels of the pixels constituting the imaging area of the CCD 2 in the vertical direction thereof. More specifically, the CCD 2 outputs a video signal in which

the pixels have been downsampled at a rate of three pixels out of four. In Fig. 6, the pixels that have been downsampled are represented by the dashed lines and pixels that have not been downsampled are represented by the solid lines.

[0036]

The enlargement ratio 2× causes an area which is half the imaging area of the CCD 2 in the vertical direction to be displayed in the display area of the display device 8. When 1/4-downsampling drive is performed, the number of pixels vertically of the video signal output from the CCD 2 is 240. Half this number of pixels is 120. This video signal having 120 pixels in the vertical direction is interpolated to a video signal having 480 pixels in the vertical direction. In 1/4-downsampling drive, therefore, the enlargement ratio 2× multiplies one pixel by a factor of four in the vertical direction (this is four-fold interpolation). In Fig. 6, the hatched pixels indicate pixels that have been interpolated.

[0037]

Fig. 7 illustrates some of the pixels of an image represented by a video signal obtained by 1/2-downsampling drive and pixels in a case where an enlargement ratio of 2× has been applied.

[0038]

When 1/2-downsampling drive is performed, the CCD

2 outputs the video signal at a rate of one pixel per two pixels of the pixels constituting the imaging area of the CCD 2 in the vertical direction thereof. More specifically, the CCD 2 outputs a video signal in which the pixels have been downsampled at a rate of one pixel out of two. In Fig. 7, the pixels that have been downsampled are represented by the dashed lines and pixels that have not been downsampled are represented by the solid lines in a manner similar to that of Fig. 6.

[0039]

When 1/2-downsampling drive is performed, the number of pixels vertically of the video signal output from the CCD 2 is 480. Half this number of pixels is 240. Interpolating this video signal having 240 pixels vertically to a video signal having 480 pixels vertically is equivalent to doubling the enlargement ratio. In 1/2-downsampling drive, the enlargement ratio 2× multiplies one pixel by a factor of two in the vertical direction (this is two-fold interpolation).

[0040]

In 1/2-downsampling drive, two-fold interpolation is performed when the enlargement ratio is set to 2× by the zoom switch 13. In Fig. 7, the hatched pixels indicate pixels that have been interpolated.

[0041]

Thus, even with the same enlargement ratio of 2×,

the resolution of an image obtained based upon a video signal acquired by 1/2-downsampling drive is higher than the resolution of an image obtained based upon a video signal acquired by 1/4-downsampling drive. The digital still camera according to this embodiment controls the CCD 2 by 1/4-downsampling drive up to an enlargement ratio of 2× and by 1/2-downsampling drive when the enlargement ratio surpasses 2×. As a result, a movie image having a comparatively high resolution is displayed on the display device 8.

[0042]

Fig. 8 is a time chart when prevails when a subject is imaged by the digital still camera. This time chart is for a case where the image-quality priority mode has been set by the mode switch 14. It goes without saying that when the motion priority mode has been set by the mode switch 14, the switching between 1/4-downsampling drive and 1/2-downsampling drive is not carried out, as will be described next.

[0043]

When the enlargement ratio that has been set by the zoom switch 13 is less than 2×, the CCD 2 is controlled by the timing generator 12 in such a manner that 1/4-downsampling drive is established. The CCD 2 outputs the video signal in sync with the imaging synchronization signal VI. The video signal is converted to digital image data that is then input to

the encoder 6 via the signal processing circuit 5 in the manner described earlier.

[0044]

The encoder 6 outputs the reproduced image data in sync with the reproduction synchronization signal VD (= 1/60 of a second). The reproduced image data is converted to an analog video signal in the digital/analog conversion circuit 7, which inputs this signal to the display device 8.

[0045]

Thus the video signal from the CCD 2 is output at a rate of once per two VD signal pulses and the movie image is changed over at a rate of once per two VD signal pulses.

[0046]

If the enlargement ratio is made 2× by the zoom switch 13 at time t, the CCD 2 is controlled by the timing generator 12 in such a manner that 1/2-downsampling drive is established. The CCD 2 outputs the video signal in sync with the imaging synchronization signal VI in a manner similar to that when 1/4-downsampling drive is applied. The video signal is converted to digital image data that is input to the encoder 6 via the signal processing circuit 5.

[0047]

The reproduced image data is output from the encoder 6 is sync with the reproduction synchronization

signal VD and is converted to an analog video signal. The latter is applied to the display device 8.

[0048]

Thus the video signal from the CCD 2 is output at a rate of once per four VD signal pulses and the movie image is changed over at a rate of once per four VD signal pulses.

[0049]

Thus, even when an image is displayed by an electronic zoom function, a movie image having a comparatively high resolution can be obtained.

[0050]

In the embodiment described above, changeover between 1/2-downsampling drive and 1/4-downsampling drive is performed in response to the enlargement ratio becoming 2×. However, it goes without saying that drive may be changed over by designating a different enlargement ratio.

[Brief Description of the Drawings]

[Fig. 1] is a block diagram illustrating the electrical construction of a digital still camera according to a preferred embodiment of the present invention;

[Fig. 2] illustrates the imaging area of a CCD;

[Fig. 3] illustrates the relationship among the image of subject obtained by 1/4-downsampling drive, a zoom area and a display area;

[Fig. 4] illustrates the relationship among the image of subject obtained by 1/2-downsampling drive, a zoom area and a display area;

[Figs. 5] (A) to (C) illustrate a plurality of schemes for driving a CCD and some of the pixels of an image represented by a video signal obtained by these drive schemes;

[Fig. 6] illustrates the relationship between 1/4-downsampling drive and interpolated pixels;

[Fig. 7] illustrates the relationship between 1/2-downsampling drive and interpolated pixels; and

[Fig. 8] is a time chart illustrating the operation of the digital still camera.

[Description of Character]

1 zoom lenz
2 CCD
5 signal processing circuit
6 encoder
8 display device
11 zoom motor
12 timing generator
13 zoom switch
14 mode switch

[Document Name]

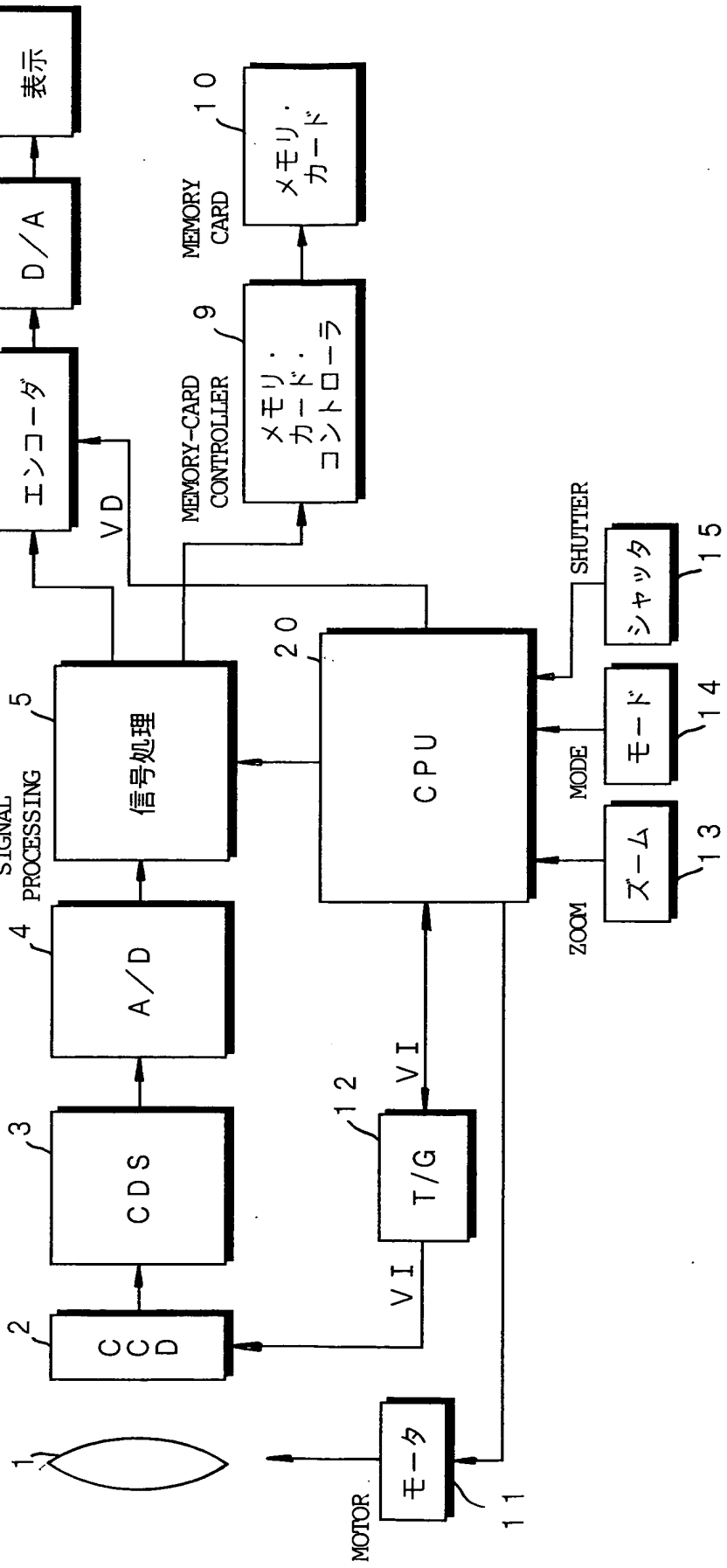
[Abstract]

[Object] To obtain a comparatively high resolution even when the image is enlarged by an electronic zoom function.

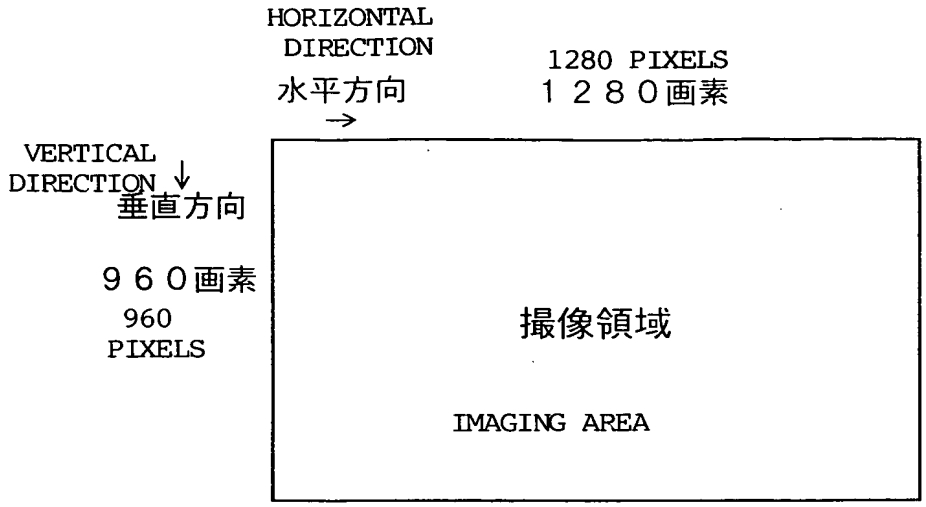
[Construction] A CCD is driven so as to output a video signal at a rate of one line out of four up to an enlargement ratio of 2×. If the enlargement ratio of 2× is surpassed, the CCD is controlled so as to output a video signal at a rate of one line out of two. Since resolution of the image represented by the video signal output from the CCD is raised, an image having a comparatively high resolution is obtained even when the image is enlarged by an electronic zoom function.

[Selected Drawing] Fig. 8

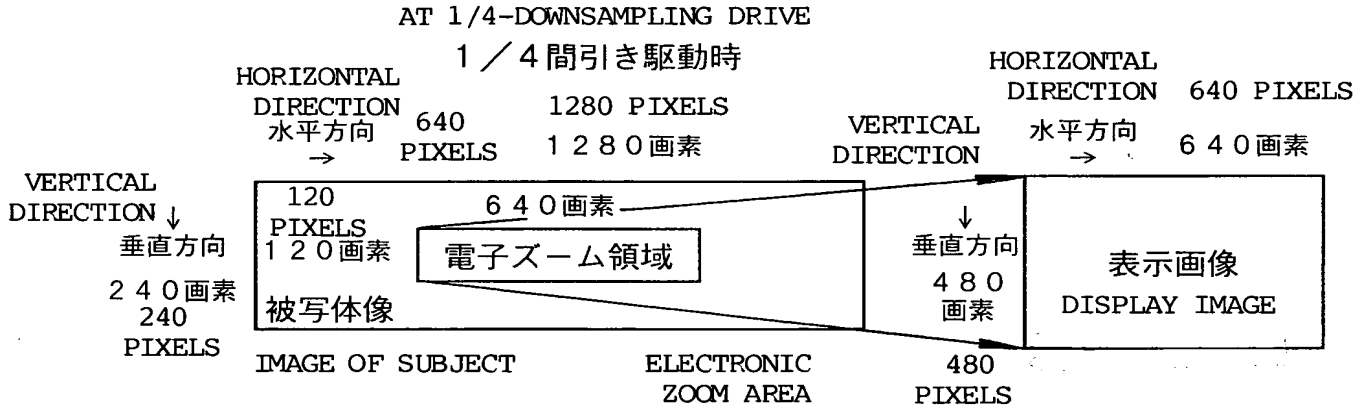
【書類名】図面　【図１】 FIG. 1
[Document Name] Drawings



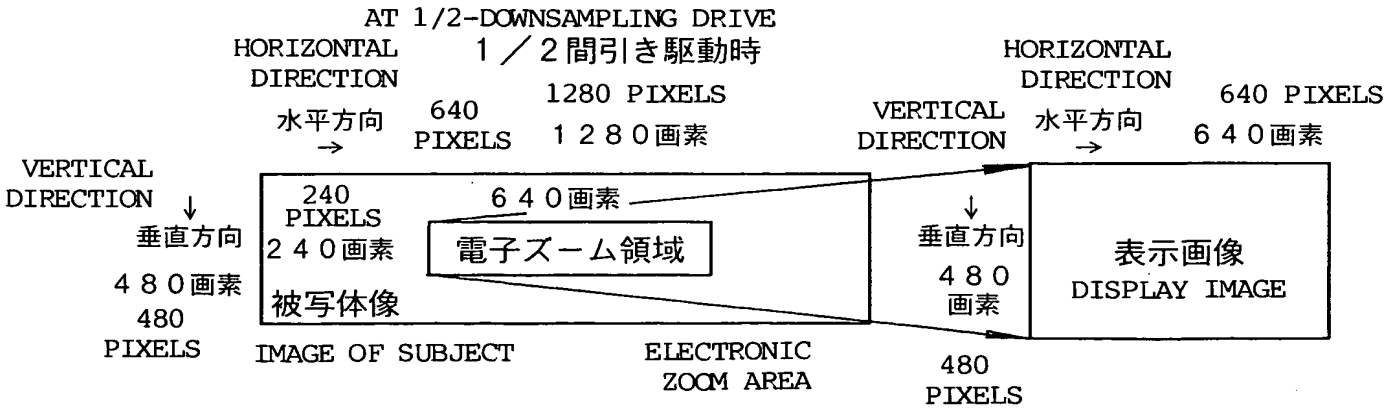
【図２】 FIG. 2



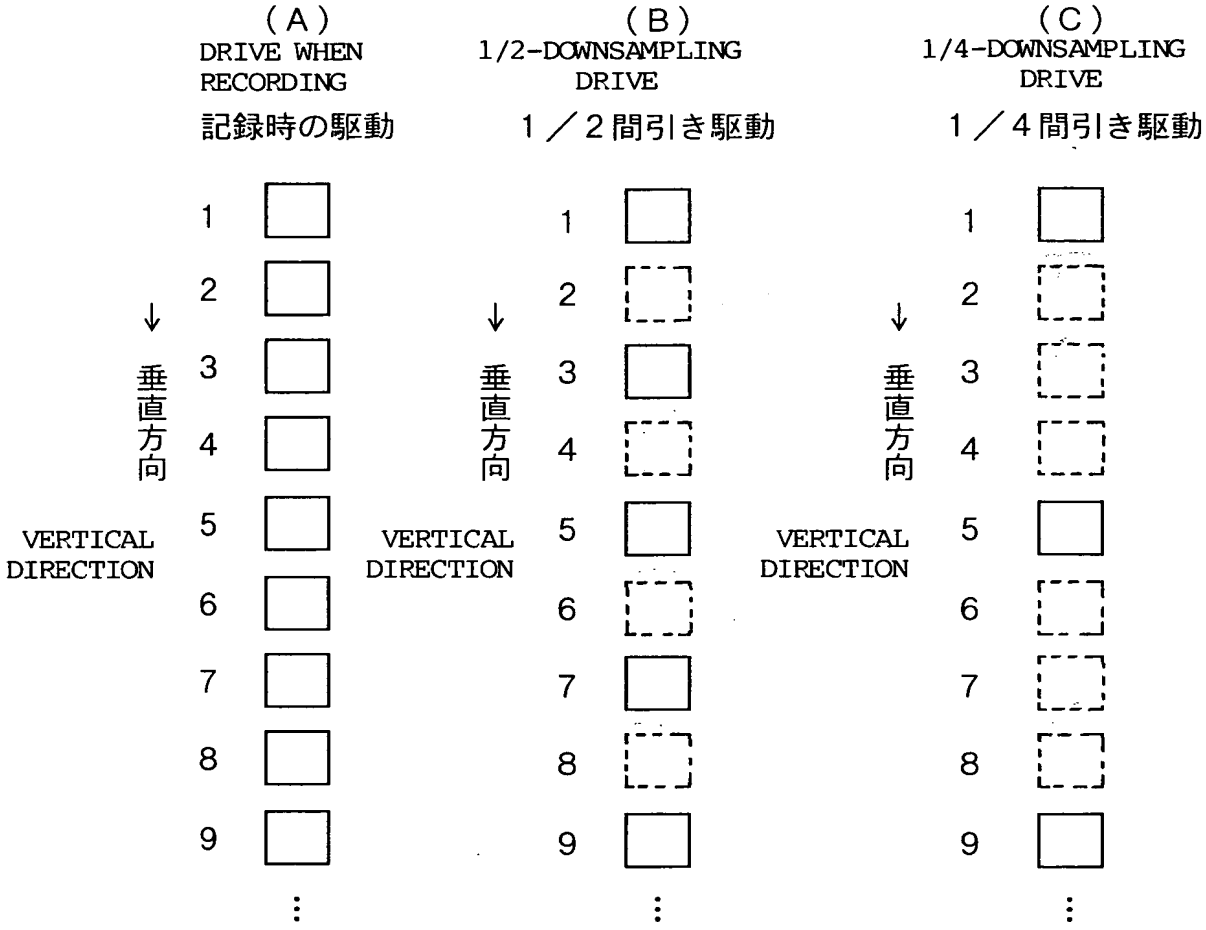
【図３】 FIG. 3



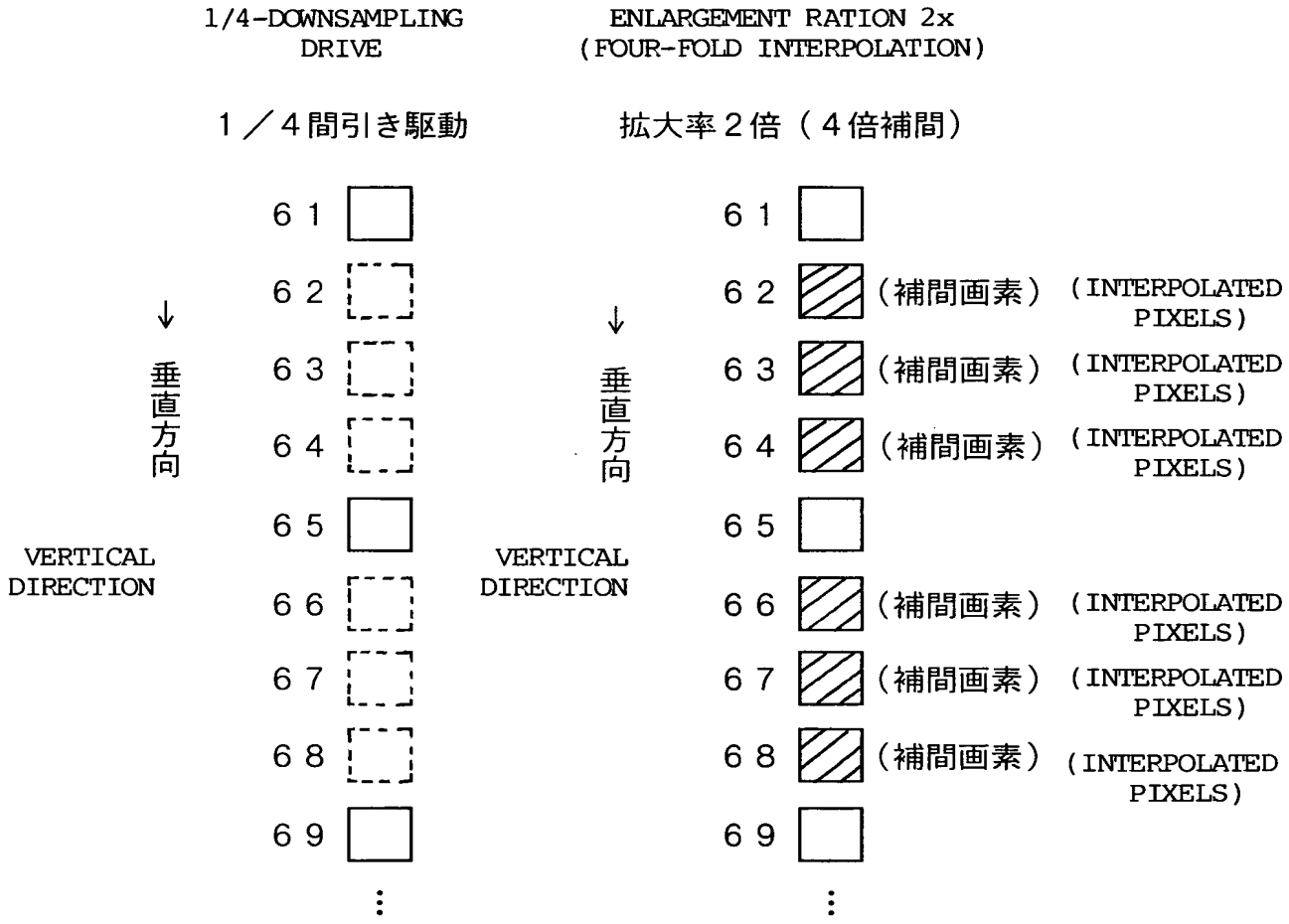
【図４】 FIG. 4



【図５】 FIG. 5



【図６】　FIG. 6



【図７】　FIG. 7

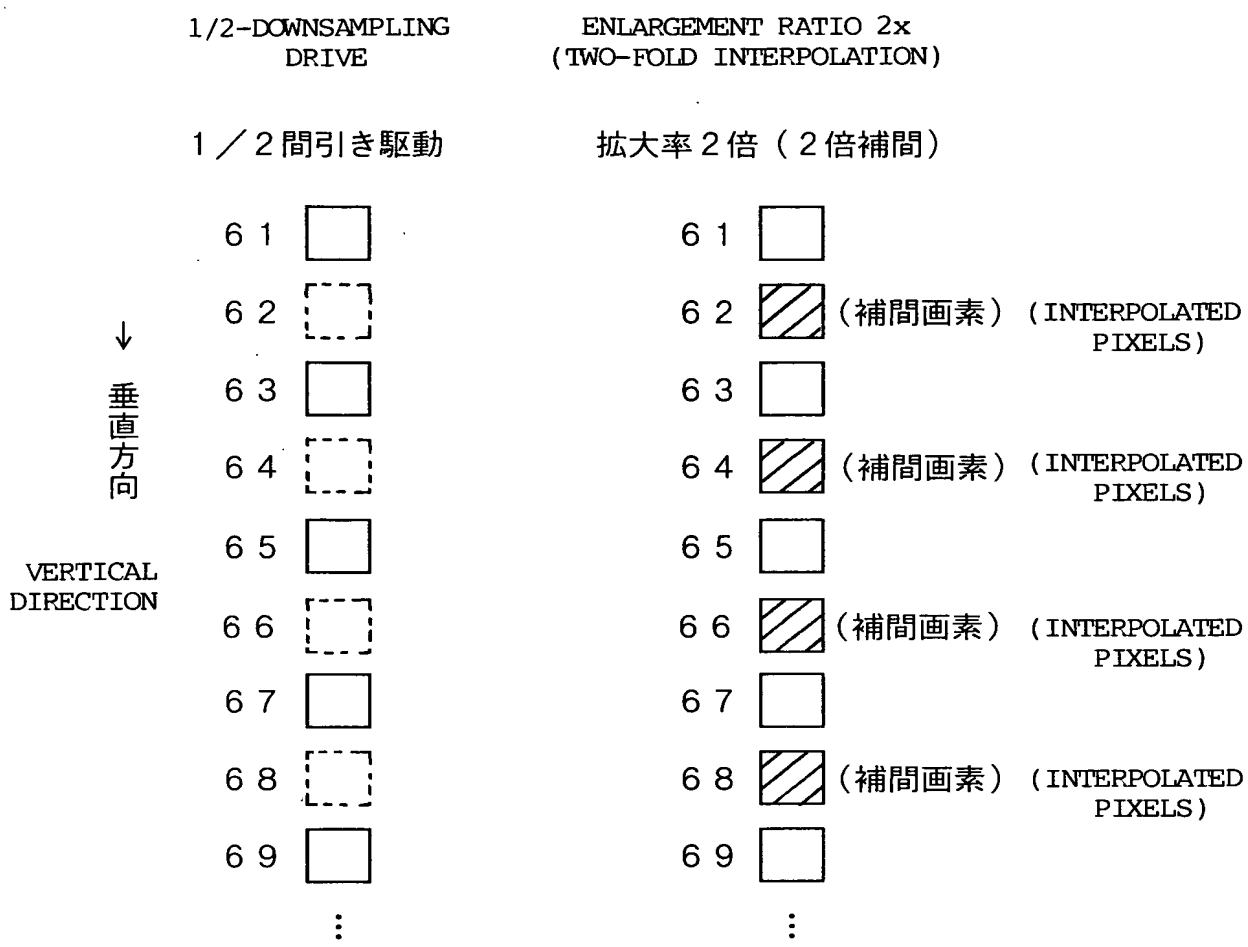


FIG. 8

【図 8】